PATENT SPECIFICATION

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(54) HOSE CONNECTIONS

(71) We, DUNLOP LIMITED, a British company, of Dunlop House, Ryder Street, St. James's, London, S.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an improved method of connecting hose elements, and in particular of connecting a hose element such as a hose, a valve, a nozzle, or a connector to another hose element.

In the manufacture of automotive hoses it is often desired to make multi-entrant or exit systems constructed in similar materials. For example a car coolant hose may require a "T" construction which, because of its complex shape, cannot easily be made in one piece but necessitates the joining of several cured components. The joining operation is usually carried out by means of conventional adhesive systems curable or otherwise e.g. neoprene solutions. However, as with most glueing operations the products are sometimes suspect in the efficiency of adhesion, and also the process is very time consuming.

Likewise, difficulty is often experienced in securing hose elements such as valves, nozzles, and connectors to the ends of hoses without the use of space consuming external clamping means.

It is an object of the present invention to provide an improved method of connecting together hose elements, and improved products so formed.

According to one aspect of the present invention a method of connecting together hose elements comprises forming a coupling of a material compatible, as hereinafter defined, with the material of at least one of the hose elements, one of the compatible materials being a thermoplastic material and the other being an at least partially vulcanised rubber composition, and joining the coupling to at least one of the hose elements by friction welding.

The compatible materials used in this invention, and defined in detail below, are rubber compositions and thermoplastics compositions that will adhere by friction welding techniques, examples being given later in the specification. Preferably the adhesion between the rubber and the thermoplastics compositions should be in excess of 5 MN/m² and more preferably in excess of 15 MN/m², although for ideal results the adhesion should be greater than the tensile strength of the vulcanised rubber composition so that failure will occur first in the rubber composition and not at the joint between the rubber and thermoplastics.

Fusion bonding techniques entail heating plastics material so that at least its surface is molten, contacting the molten surface with the compatible rubber composition, and allowing the plastics material to cool in contact with the compatible rubber.

The heating required to friction weld the coupling to a hose element may be generated by moving the coupling and hose element with a relative movement which may, for example, be linear, rotary, or oscillatory. Pressure applied between the coupling and hose element during relative movement is selected having regard to the shape of the coupling and hose element and the materials from which they are formed, but a pressure in the range of 100 to 500 KN/m² will be suitable in many applications.

The method of the present invention may be used ofr the connection of rubber hoses in which case the coupling will be made of a compatible thermoplastics composition, or the invention may equally well be used to connect plastics hoses in which case the coupling will be made from a compatible rubber composition.

Whilst the present invention is particularly suitable for joining two or more rubber or plastics hoses, it may also be used permanently to attach a rubber or plastics hose to other solid or hollow hose elements, for example fittings such as valves, nozzles, or connectors. Whilst these other solid or hollow fittings should preferably be made of a material compatible with that of the coupling, they may be made of non-compatible materials, e.g. plastics, rubbers, metals or any

Plastics	Rubber
Poly(ethylene terephthalate).	Polyepichlorohydrin.
Poly(tetramethylene terephthalate).	Styrene/butadiene. Nitrile. Polybutadiene. Epichlorohydrin/ethyleneoxide.
Polar elastoplastic linear block copolymers containing polyester blocks and polyether blocks such as copolymers available under the trade name Hytrel (R.T.M).	Polyepichlorohydrin. Epichlorohydrin/ethyleneoxide. Natural. Styrene/butadiene. Nitrile. Polyurethane. Acrylate. Polychloroprene. Propyleneoxide/unsaturated epoxide. Polybutadiene.
Polyamide, particulary those having from 3 to 12 methylene groups between the amide groups, e.g. nylon 4 to nylon 13.	Polyepichlorohydrin. Sulphur-cured polyurethane. Nitrile. Vinylidene flouride. fluoro-elastomer. Natural. Polychloroprene. Trans-polypentenamer. Styrene/butadiene. Polybutadiene.
Polycarbonates, preferably polyesters of carbonic acid which are derived from dihydroxyl compounds in which the hydroxyl groups are directly attached to aromatic rings.	Nitrile. Polyepichlorohydrin. Polybutadiene.
Vinyl chloride polymers, e.g. poly(vinyl chloride), poly(vinyl dichloride, and poly(vinylidene chloride).	Nitrile.
Poly(vinylidene flouride).	Acrylate.
Styrene/acrlonitrile copolymers.	Nitrile.
Perspex (R.T.M.) (methyl methacrylate resin).	Polyepichlorohydrin. Nitrile.
Poly(chlorotrifluoroethylene)	Styrene/butadiene.
Polyurethane	Styrene/butadiene. Natural.
Polyformaldehyde	Polyepichlorohydrin. Epichlorohydrin/ethyleneoxide.

In the above definition of "compatible materials" the vinylidene fluoride fluoro-elastomer is a copolymer of vinylidene fluoride with one or more other fluoro-olefins such as chlorotrifluoroethylene, hexafluoropropene, tetrafluoroethylene, dichlorodifluoroethylene, chlorofluoroethylene, fluorinated vinyl esters, fluoro-acrylic acid derivatives, fluorinated alkylvinylethers (e.g. perfluorovinyl perfluoro-alkyl ether) and 1,2,3,3,3 - pentafluoropropene. Examples of suitable copolymers are those available under the Registered Trade Mark names Viton A, Viton B, Viton E60C, Fluorel and Tecnoflon.

The rubber and/or thermoplastics may be in a compound with the usual ingredients such as fillers, pigments, anti-ageing agents, stabilising agents, plasticizers and dry-bonding ingredients.

It is found that in order to achieve or improve the bond between certain vulcanized rubber and thermoplastics materials it is necessary to pre-treat the surface of at least one of them, especially when the rubber is a vulcanizate of a hydrocarbon polymer having at least one double bond for each six main chain carbon atoms. Suitable pre-treatments include subjecting the surface to chemical treatment

is not great, and furthermore that the relative movement between the tubular portion and hose will maintain the plastics material therebetween in a molten condition until rotation is stopped.

In a modified form of this method the radially outer surface of the tubular portion may be contoured, for example with helically extending grooves, or otherwise shaped, to promote easy flow of molten material around the tubular portion.

In a further modified form of the method the outer surface of the tubular portion at its end which contacts the coupling sleeve 12 may be contoured with a frusto-conical shape so as to provide an annular chamber of generally triangular cross-sectional shape through which molten material from the coupling sleeve may flow relatively readily, and preferentially, in an axial direction into the space around the tubular portion.

WHAT WE CLAIM IS:—

1. A method of connecting together hose elements comprising forming a coupling of a material compatible, as hereinbefore defined, with the material of at least one of the hose elements, one of the compatible materials being a thermoplastic material and the other being an at least partially vulcanised rubber composition, and joining the coupling to at least one of the hose elements by friction welding.

2. A method according to Claim 1 wherein the hose elements for connection together are each formed from an at least partially vulcanised rubber composition or each formed of a thermoplastic composition and the coupling is of a compatible material of either thermoplastic composition or an at least partially vulcanised rubber composition respectively.

3. A method according to Claim 1 or 2 wherein the hose elements for connection together are formed of different materials one of which is incompatible with the material of the coupling, an interlayer of material compatible with the coupling material and the hose element material which is incompatible with the coupling material being provided on either the coupling or said hose element, and subsequently friction welding the interlayer to either said hose element or the coupling respectively.

4. A method according to any one of the preceding Claims comprising connecting a hose to a hose fitting having a tubular portion for location in the bore of the hose by inserting a coupling of compatible material shaped substantially in the form of a sleeve in the end of the hose at a position spaced from the end of the hose and moving the tubular portion of the hose fitting in friction contact with an end of the coupling to fuse the coupling to the hose and the hose fitting.

5. A method according to Claim 4 wherein the coupling sleeve is held in position in the bore of the hose during the friction welding operation by removable clamping means which acts on the outer surface of the hose.

6. A method according to Claim 4 or Claim 5 wherein the outer diameter of the tubular portion of the hose fitting for location in the bore of the hose has a diameter smaller than the bore of the hose.

7. A method according to Claim 6 wherein the outer diameter of the tubular portion is between 0.05 and 1.02 millimeters less than the bore diameter of the hose.

8. A method according to any one of Claims 4 to 7 wherein the radially outer surface of the tubular portion of the hose fitting is contoured to promote flow of molten material between said tubular portion and bore of the hose.

9. A method according to any one of the preceding Claims wherein friction welding is performed by moving in contact with each other the materials to be joined with either a relative rotary or relative oscillatory movement.

10. A method of connecting together hose elements substantially as hereinbefore described with reference to Figure 1, Figure 2 or Figure 3 of the accompanying drawings.

11. A method of connecting a hose fitting to a hose substantially as hereinbefore described with reference to Figure 4 of the accompanying drawings.

12. An assembly comprising hose elements connected together by a method according to any one of the preceding Claims.

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

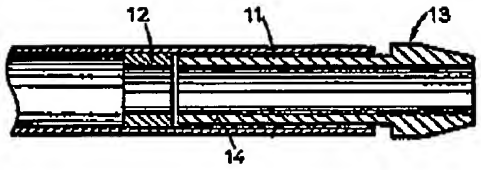

FIG. 4.